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Action-angle variables in the theory of superconductivity and superfluidity phenomena

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Abstract

The problem of two bodies that interact in such a way that they describe a rotational motion in Euclidean (pseudo-Euclidean) space is considered within the framework of a classical-mechanics formalism. It is shown on the basis of the Hamiltonian equations of motion that the system can be described in action-angle variables. While not planar, its phase space exhibits the properties of a Köhler manifold, which permits exact quantization of the classical system. The results of quantization are easily identified with known quantum models that describe superconductivity and superfluidity phenomena, making it possible to transfer the properties of the classical system to those of the quantum system, whose evolution can therefore also be described in action-angle variables.